

Thermal Barrier Coatings

Thermal barrier coatings (TBC's) are used extensively by jet aircraft engine manufacturers to insulate turbine blades and other combustion chamber components from the extreme temperatures ($> 2000^{\circ}\text{F}$) of the combustion gases. Higher combustion gas temperatures lead to increased engine operating efficiency. Therefore, there is substantial interest in reducing the thermal conductivity of TBC's to allow higher engine operating temperatures or, alternatively, reduced TBC weight while holding engine operating temperature constant. At Los Alamos National Lab, we have been working for approximately the past 7 years with various industrial partners to develop advanced TBC's for jet engine and nuclear weapon applications. With respect to jet engine applications, our goal is to develop TBC's having significantly reduced thermal conductivity relative to the current state-of-the-art which is based on yttria-stabilized zirconia (YSZ) thin films. Our current focus is on electron beam evaporation (Figure 1) since this has been shown to be the method of choice for producing TBC's for use in extreme chemical environments and where thermal cyclic fatigue is an important issue. Figure 2 shows a YSZ coated "shock paddle" used in experiments to assess the thermal shock performance of TBC's in turbine engine environments. Figure 3 shows a scanning electron microscope image of the columnar microstructure of a typical YSZ TBC deposited at temperatures in excess of 700°C .

Figures

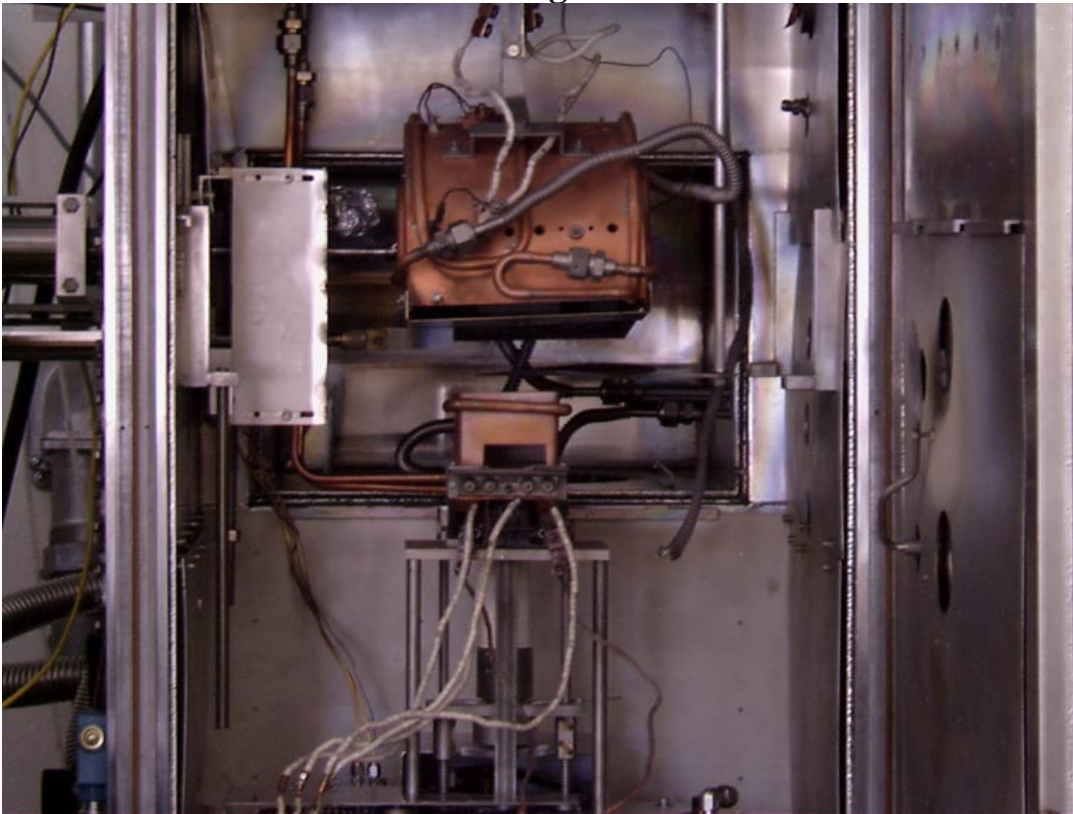


Figure 1.

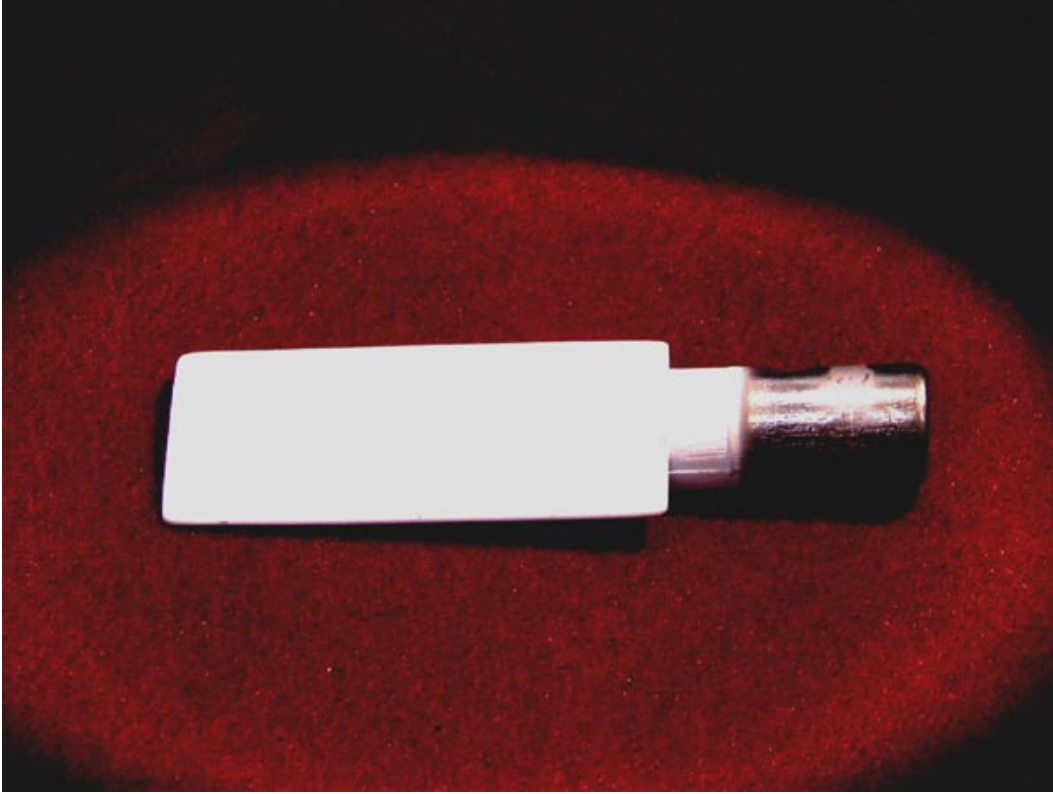


Figure 2.

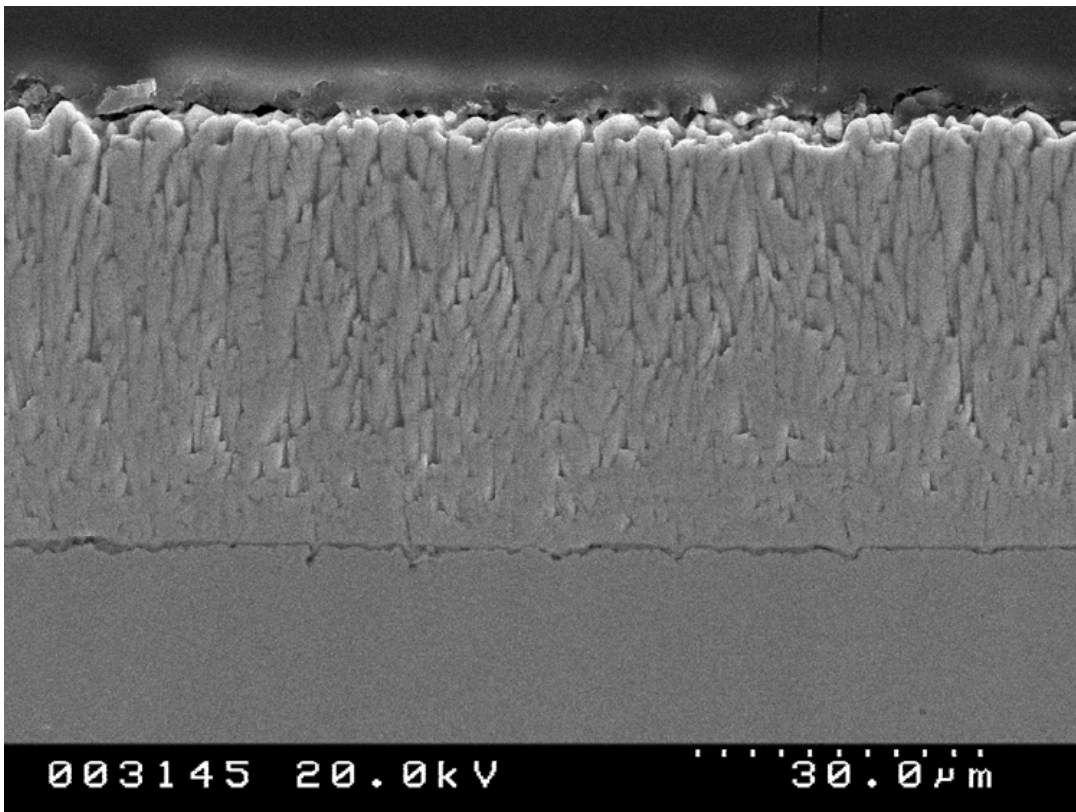


Figure 3.

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